REMARKS

Claims 26-32, 39-42, 53, 54, and 65 have been withdrawn from consideration and are canceled from the present application. Claims 61-64 and 66-68 are cancelled. Claims 100-103 have been added. The claims remaining in the present application are 1-25, 33-38, 43-52, 55-60, and 69-103.

Supplemental Disclosure Statement and PTO 1449 :

For completeness, the Applicant would like to cite the following additional patents to complement the original list provided with the filed patent application. These additional patents and patent applications generally relate to the use of wire grid polarizers in projection systems.

U.S. Patent No. 6,447,120 (Hansen et al.)
U.S. Patent No. 6,486,997 (Bruzzone et al.)
U.S. Patent No. 6,511,183 (Shimizu et al.)
U.S. Patent No. 6,585,378 (Kurtz et al.)*
U.S. Patent No. 6,661,475 (Stahl et al.)
U.S. Patent No. 6,669,343 (Shahzad et al.)
U.S. Pub. No. US 2003-0081179 (Pentico et al.)

* assigned to the same assignee as the present invention

The above prior art patents were not cited by the Applicant at the filing of the present invention, nor identified by the Examiner in the first Office Action related to the present invention. The field of electronic projection systems specifically employing wire grid polarizers is both relatively small and recent, therefore it is not inconvenient to cite the prior art more extensively in this detail. As the modern patent examination process more fully recognizes applications concurrent to the application under examination, and the prior art cited above has relevance to varying degrees, this examination will be more complete if these documents are considered. A Supplemental Information Disclosure Statement, PTO-1449, and copies of the prior art are enclosed with this response.

One of the recently issued patents listed above, U.S. Patent No. 6,585,378 (Kurtz et al.), is assigned to the same assignee as the present application, and was identified (as U.S. Patent Application Serial No. 09/813,207)

in the present invention as a disclosure incorporated therein. This Kurtz '378 patent, which was filed on March 20, 2001, describes display systems and modulation optical systems that employ various useful combinations of spatial light modulators and wire grid polarizers. In particular, Kurtz '378 discloses a modulation optical system 200 (see Figure 4) that comprises a spatial light modulator 204, which works in combination with a pre-polarizer 212, a wire grid polarization beamsplitter 224, and a polarization analyzer 228. The Kurtz '378 patent discloses (see Figure 4b and Col. 10, line 46 through Col. 11, line 6) that it is preferential to position the wire grid polarization beamsplitter 224 with the sub-wavelength wires 227 facing the modulator (liquid crystal device) 204, such that the illumination light is transmitted through the substrate 226, as thermally induced stress birefringence effects within the substrate are minimized.

Additionally, the Kurtz '378 patent also discloses the potential use of a polarization compensator within optical systems employing combinations of wire grid polarizers and spatial light modulators. Specifically, Kurtz '378 shows a compensator 206 in Figures 4a and 6 (and in Figure 4b, unlabeled), located between a spatial light modulator 204 and a wire grid polarization beamsplitter 224. Compensator 206 is described (see Col. 11, line 59 through Col. 12, line 43) as comprising a waveplate that provides a small amount of retardance to compensate for geometrical imperfections and residual birefringence effects with the spatial light modulator 204. The relevance of the Kurtz '378 reference to both the present invention and to the above listed prior art will be discussed subsequently in this response.

With respect to this additional prior art, the Applicant has reviewed U.S. Patent No. 6,447,120 (Hansen et al.), which was filed on May 21, 2001, in advance of the January 7, 2002 filing of the present invention. Hansen '120 generally teaches the construction of an image projection system 10 having a wire grid polarizer as the beam splitter. Hansen '120 does show a system (Figure 6) having both a pre-polarizer 82 and a post-polarizer 84 positioned about the wire grid polarization beamsplitter 14 in a manner that is generally similar to that employed in the present invention. Hansen '120 emphasizes the teaching of improved wire grid polarization beamsplitters, and their use in a display system. Specifically, Hansen '120 teaches an embedded wire grid polarizer 200 (see Figure 9), a polarization beamsplitter having a substrate with good optical flatness

(see Col. 23, lines 18-39), an optical substrate less than 5 mm thick (see Col. 23, lines 40-43) and a polarization beamsplitter having a substrate with minimal geometrical distortion (optical wedge) (see Col. 23, lines 44-55). The claims of Hansen '120 describe image projection systems with these attributes.

Notably, Hansen '120 does not provide several key aspects of the present invention. In particular, Hansen '120 does not provide for a display system having a polarization compensator. Hansen '120 further does not disclose the use or design of polarization compensators that correct for wire grid polarizers, wire grid polarization beamsplitters, or spatial light modulators (including liquid crystal devices) either individually or in combination. Hansen '120 does not recognize the importance of the sub-wavelength wire orientation, as best positioned towards the LCD (and away from the illuminating beam), in order to obtain maximum contrast. As the present invention teaches and claims these key aspects, and several others, which are not described by Hansen '120, the Hansen '120 prior art patent is not considered to be specifically materially pertinent to the concepts disclosed in the present invention.

U.S. Patent No. 6,486,997 (Bruzzone et al.) was filed on May 17, 1999, in advance of the January 7, 2002 filing of the present invention. Bruzzone '997 teaches an optical imaging system 10 (see Figure 1) which utilizes three reflective imagers (26, 28, and 30) which interact with a common color splitter/combiner prism 36. The light that transits the prism 36 interacts with an adjacent Cartesian polarization beamsplitter 50, which can either be a cube prism polarizer or a plane plate type polarizer, and then image light is sent to the screen by projection lens 34. The system of Bruzzone '997 may also be equipped with a pre-polarizer and a polarization analyzer (see Col. 8, lines 55-58).

A key aspect of Bruzzone '997 is that the image display system must employ a <u>Cartesian polarization beamsplitter (PBS)</u>, the primary example of which is a 3M advanced film Cartesian PBS (see Col. 7, lines 6-25). Bruzzone '997, defines a Cartesian PBS as having a fixed material axis of polarization (see Col. 6, lines 54-64), such that the polarization of separate beams is referenced to invariant (fixed), generally orthogonal, principal axis of the polarizer (see Col. 3, lines 60 through Col. 4, line 4). Bruzzone '997 further stipulates (see Col. 4, lines 17-27) that the Cartesian PBS substantially reflects those components of a beam of light which are polarized along a fixed material axis. Those components of a

beam of light with polarization not along the material axis are then substantially transmitted. The Cartesian PBS thus splits incident light into a first and a second substantially polarized beams having polarization states referenced to the fixed polarization axes.

Bruzzone '997 says that the Cartesian PBS can be a cube PBS, or a free-standing (thin plate) device. The primary cited example of a Cartesian PBS is a 3M advanced film PBS (see Col. 7, lines 6 through Col. 8, line 31) made from birefringent polymeric multi-layer polarizing film. Bruzzone '997 also classifies a wire grid polarization beamsplitter as a Cartesian PBS (see Col. 4, lines 27-35), and further shows a projection system 110 (see Figure 2) in which the Cartesian PBS 150 is a free-standing device such as a wire grid polarizer (see Col. 9, lines 11-20).

Bruzzone '997 describes a Cartesian PBS as a wide angle device (>11° cone), whose polarization response is substantially independent of the angle of incidence of the incident light beams (see Col. 3, line 60 through Col. 4, line 13), such that the polarization of skew rays is not significantly rotated with respect to principal rays (Col. 15, lines 42-49). Bruzzone '997 further describes a "de-polarization cascade" (see Col. 13, lines 53-66) as a condition in which skew rays first encounter a differential polarization response from the PBS, followed by a subsequently further variant polarization response off the reflective LCD (Figure 18) and any other optics. Bruzzone '997 shows that a standard MacNeille PBS will contribute significant differential skew ray de-polarization, and then further "amplify" the effects after reflection off the imager. Bruzzone '997 states that the Cartesian PBS (including wire grid device) has the advantage that it will not amplify a de-polarization cascade that other nearby optics may have introduced. Bruzzone '997 further says that a Cartesian PBS will not cause significant de-polarization of skew rays, except maybe from de-polarization from the reflecting surfaces, and also will not amplify or contribute to a de-polarization cascade (see Col. 15, lines 42-67). As result of all this, Bruzzone '997 (see Col. 15, lines 63-65) declares that contrast degradation from large angle and skew ray depolarization, as well as de-polarization cascading, will be negligible or non-existent from a Cartesian PBS.

Bruzzone '997 has some commonality with the present invention, in that both documents describe projection systems that employ wire grid

polarization beamsplitters in combination with LCDs and polarization compensators. As a first important difference, the present invention describes (see page 16, line 26 through page 17, line 8) that the orientation of the sub-wavelength wires relative to the spatial light modulator, is critical. In particular, it is presented that an exemplary contrast drops by >10x (from 2900:1 to 250:1) when the wires are switched from being oriented towards the modulator to towards the illumination light. As was described in greater detail in the commonly-assigned Kurtz '378 patent (see Col. 10, line 39 through Col. 11, line 6), proper wire orientation with respect to the modulator reduces thermally induced stress birefringence effects, thereby minimizing de-polarization effects and maximizing contrast. Depolarization from stress induced birefringence will effect all rays, including both oblique and skew light rays. Notably, Bruzzone '997 does not anticipate that a plate type Cartesian PBS generally, or a wire grid PBS in particular, may have structural or orientional issues relative to the modulator and illumination that can cause significant stress induced birefringence and the related de-polarization effects. (Bruzzone '997 does say that a horizontal or vertical orientation can make a difference (see Col. 23, lines 20-54)). Bruzzone '997 neither shows the sub-wavelength of the wire grid polarizer in any of its figures, nor specifies any wire orientational preference relative to the modulator. Thus, the Bruzzone '997 definition of a wire grid PBS as a Cartesian non-depolarizing PBS could be regarded as incomplete, as significant inherent wire grid polarizer de-polarization effects are not anticipated.

As another key aspect, as Bruzzone '997 teaches that Cartesian PBS's (and wire grid PBS's in particular) are inherently free from skew ray de-polarization effects, Bruzzone '997 does not anticipate many key aspects of the present invention. In particular, the present invention discloses the construction of a modulation optical system employing polarization compensators (retarders) that can provide skew ray de-polarization correction for wire grid polarizers and wire grid polarization beamsplitters. Specifically, the present invention provides two examples (see page 28, line 31 through page 30, line 7) in which polarization compensation of the wire grid PBS corrects for oblique and skew ray de-polarization effects, reducing leakage light by 2-3x. As the present invention seeks a high modulation contrast (1,000-2,000:1 or higher) compared to the ~200:1 target of Bruzzone '997 (see Col. 16, lines 1-10), it is understandable that

the present invention seeks to control small depolarization effects that Bruzzone '997 overlooks.

Moreover, the present invention teaches the construction of a modulation optical system employing polarization compensators that can provide correction not only for the wire grid polarization beamsplitters, but also for wire grid polarizers generally, as well as for spatial light modulators, or for the wire grid polarizers and modulators in combination, none of which are anticipated by Bruzzone '997. It should be noted that Bruzzone '997 does disclose (see Col. 18, lines 5-8) the use of a quarter wave plate in combination with an LCD (a ferro-electric LCD or FLCD), and provides an associated dependent claim (10) linking a quarter wave compensator to use in a system with a Cartesian PBS. Bruzzone '997 is somewhat vague, but the claimed compensator is likely associated with the compensation of the FLCD, rather than any other component. By comparison, as noted in the present invention (see page 9, lines 6-15), and also discussed in greater detail in the commonly-assigned Kurtz '378 patent (see Col. 12, lines 23-43), the use of a conventional quarter wave plate compensator with a wire grid polarization beamsplitter can actually significantly degrade the contrast ratio, and specifically optimized compensators are required to obtain good results. Thus, in summary, it can be understood that the present invention addresses de-polarization effects related to induced stress birefringence and skew ray propagation, by providing a modulation optical system with a properly oriented wire grid PBS and properly optimized polarization compensators, in ways which are not anticipated by Bruzzone '997, and that therefore the present invention is patentable even given the presence of Bruzzone '997.

U.S. Patent No. 6,511,183 (Shimizu et al.) was filed on June 2, 2001, in advance of the January 7, 2002 filing of the present invention. Shimizu '183 primarily discloses an image projector 500 (see Figure 7) having a scrolling color design, in which light is split into three color beams that are swept through space by rotating prisms 552 such that the beams travel sequentially across a polarization modulator 580. Shimizu '183 further teaches the use of a plate supported, surface mounted, fixed-polarization axis, thin polarizer, polarizing beamsplitter as a key element within this system. Accordingly Shimizu '183 instructs that this plate polarization beamsplitter can be a wire grid polarization beamsplitter 100 (as depicted in Figure 4), comprising a plurality of electric

conductors 102. Shimizu '183 depicts wire grid polarization beamsplitter 570 as located prior to the modulator 580 (see Figure 7), with the wire grid 574 on the side of the substrate 572 that faces away from the illumination (see Col. 31, lines 50-65). Shimizu '183 correctly anticipates (see Col. 25. line 52 through Col. 26, line 10) that stress birefringence and contrast loss from polarization disturbance are avoided by using the wire orientation away from the illumination light. Finally, Shimizu '183 teaches an alternate digital image projector 400 (see Figure 11) that utilizes three polarization modulators 440 located around a color dividing/combining prism assembly 436.

Shimizu '183 has some commonality with the present invention. In particular, Shimizu '183 teaches the construction of a modulation optical system using a wire grid polarization beamsplitter having the sub-wavelength wires facing away from the modulator (LCD), as a means to obtain increased contrast. However, in this respect, as the previously discussed Kurtz '378 patent, which is assigned to the same assignee as the present invention was filed March 20, 2001, in advance of the June 2, 2001 filing of Shimizu '183, it is established that the Applicant possessed prior relevant knowledge, and was the first to disclose and the first to invent. Therefore, it is respectfully submitted that Shimizu '183 is not a proper prior art reference for the present invention (Mi' 663).

Additionally, Shimizu '183 misses many key aspects of the present invention. Most importantly, Shimizu '183 draws attention (see Col. 10, line 57 through Col. 11, line 30) to the fact that many prior art projection systems utilize retarders (or quarter wave foils) to correct for the de-polarization effects/leakage common to the industry standard MacNeille type polarization beamsplitter prisms. Shimizu '183 teaches that the use of wire grid polarization beamsplitters significantly reduces the dark state leakage, as compared to the MacNeille type prism (see Col. 17, lines 14-28). Shimizu '183 then concludes (see Col. 25, lines 16-30) that with the use of a plate supported fixed polarization axis thin polarizer polarizing beamsplitter (of which a wire grid polarizing beamsplitter is an example), that skew angle depolarization is largely avoided, and that there is no need for a quarter-wave foil to improve contrast. In effect, Shimizu '183 teaches away from the present invention, as the present invention discloses the construction of a modulation optical system employing optimized polarization

compensators (retarders) that can provide de-polarization correction for wire grid polarizers and wire grid polarization beamsplitters, as well as for spatial light modulators, or for the wire grid polarizers and modulators in combination. Additionally, Shimizu '183 also does not teach the preferred architecture of the modulation optical system of the present invention, which uses a pre-polarizer, a wire grid polarization beamsplitter, a polarization analyzer, and polarization compensator in combination with a spatial light modulator (LCD).

U.S. Patent No. 6,661,475 (Stahl et al.) was filed on March 23, 2000, in advance of the present invention. Stahl '475 discloses an optical system 10 (see Figure 1) utilizing a transreflective polarizing beamsplitter 40 (that is preferably a wire grid device) in combination with a pleochroic color filter 48, a spectrally sensitive output waveplate 56, and three liquid crystal displays (LCDs) 26. Stahl '475 seeks (see Col. 2, lines 1-30) to use a sheet type linear polarizer, such as wire grid polarization beamsplitter, so as to avoid the stress birefringence and skew ray depolarization common to PBS cube prisms.

Notably, Stahl '475 does not describe a system similar to that of the present invention, which employs a pre-polarizer, a wire grid polarization beamsplitter, a polarization analyzer, and polarization compensator in combination with a spatial light modulator (LCD). In particular Stahl '475 does not anticipate the use of a polarization compensator of the type of the present invention, which can provide de-polarization correction for wire grid polarizers and wire grid polarization beamsplitters, as well as for spatial light modulators, or for the wire grid polarizers and modulators in combination. Stahl '475 also does not recognize that superior polarization contrast is realized if the sub-wavelength wires of the wire grid polarization beamsplitter are oriented towards the LCD and away from the illumination light. Indeed, the configuration of Stahl '475 inherently imparts a differential polarization response from the wire grid polarization beamsplitter 40 to different color channels, as two color channels (26_2, 26_3) provides imaging light to the projection lens 27 in transmission and the third color channel (26_1) provides imaging light to the projection lens 27 in reflection. Furthermore, Stahl '475 claims display systems that depend on the use of both a color filter beamsplitter (pleochroic filter) and a spectrally selective output device (waveplate) which are elements that are not common to the present

invention. Thus, additional prior art patent Stahl ' 475 is not considered to be specifically materially pertinent to the concepts disclosed in the present invention.

U.S. Patent No. 6,669,343 (Shahzad et al.), which was filed on May 31, 2001, in advance of the January 7, 2002 filing of the present invention, discloses an image display system 300 that is generally of the scrolling color type (see Figure 3) that is similar to the system described in the previously discussed Shimizu '183 patent. Shahzad '343 equips the image display system 300 with a substantially non-absorptive polarizing element 326, which may comprise a polarizing beamsplitter, including a wire grid polarizer (see Col. 5, lines 1-6). Most broadly, Shahzad '343 claims an image display system having a polarizing element (wire grid pre-polarizer) which is used to re-direct light of a colored light beam based on polarization. While this aspect of Shahzad '343 is generally common to some of the embodiments disclosed in present invention, these aspects are also common to the previously discussed Kurtz ' 378 patent. As Kurtz '378 was filed March 20, 2001, in advance of the May 31, 2001 filing of Shahzad '343, it is established that the Applicant possessed prior relevant knowledge, and was the first to disclose and the first to invent. Moreover, Shahzad '343 does not teach many of the critical elements of the present invention, including the use of a modulation optical system which combines a wire grid polarization beamsplitter with a polarization compensator. In particular, Shahzad '663 does not provide for the use of a polarization compensator of the type of the present invention, which can provide de-polarization correction for wire grid polarizers and wire grid polarization beamsplitters, as well as for spatial light modulators, or for the wire grid polarizers and modulators in combination. Thus, additional prior art patent Shahzad '343 is not considered to be specifically materially pertinent to the concepts disclosed in the present invention.

The present invention also overlaps with a co-pending patent application, U.S. Patent Application Publication No. 2003/0081179, by Pentico et al., (referred to herein as Pentico '179), which was filed as a provisional application on August 6, 2001, in advance of the January 7, 2002 filing of the present invention. Pentico '179 discloses a "display apparatus" or "modulation optical system" comprising many elements common to the present invention. In particular, Pentico '179 describes an electronic projection system (shown in Figures 2 and 4) that comprises a light source, one or more spatial light

modulators (display panels or micro-displays 234 and 244), a light separator 220 (which generally can be a polarizing plate beamsplitter (see paragraph 0031), and which specifically can be a wire grid polarizer (see paragraph 0030)), and one or more polarization analyzers 235, 245, wherein the analyzers (see paragraph 0042) can further comprise an optical retarder element which can provide polarization compensation for the optical retardance of the panel. Thus, Pentico '179, like the present invention, describes a modulation optical system that incorporates both a wire grid polarization beamsplitter and a polarization compensator (retarder) in combination with a spatial light modulator (LCD)

Notably, the previously discussed Kurtz '378 patent, which is assigned to the same assignee as the present invention, also discloses the use of a polarization compensator within optical systems employing combinations of wire grid polarizers and spatial light modulators. Again, Kurtz '378 shows a compensator 206 in Figures 4a and 6 located between a spatial light modulator 204 and a wire grid polarization beamsplitter 224. Compensator 206 is described (see Col. 11, line 59 through Col. 12, line 43) as comprising a waveplate that provides a small amount of retardance to compensate for geometrical imperfections and residual birefringence effects with the spatial light modulator 204. Kurtz '378 and Pentico '179 disclose common base elements (optical modulation systems with spatial light modulators, wire grid polarization beamsplitters, polarization analyzers, and optical retarders/compensators) that are also common to the present invention. However, as Kurtz '378 was filed March 20, 2001, in advance of the provisional application (filed August 6, 2001) linked to Pentico '179, it is established that the Applicant possessed prior relevant knowledge, and was the first to disclose and the first to invent. Therefore, it is respectfully submitted that Pentico '179 is not a proper prior art reference for the present invention.

Additionally, Pentico '179 and the present invention have significant differences. Pentico '179 describes a system (see Figure 2) that comprises a polarization analyzer 235, 245 which is located adjacent to a light combiner 250, wherein said analyzer (see paragraph 0042) may also include an optical retarder element that may compensate for the optical retardance of the panel (234, 244). Pentico '179 specifically discusses a prior art "color management optical system" (see Figure 1) known as the ColorQuad, which was

developed by ColorLink Inc., and is described in prior patents, including U.S. Patent No. 6,183,091 (Johnson et al.). As noted by Pentico '179, the ColorQuad optical arrangement utilizes a combination of polarizing beamsplitters and color selective retardation elements. These color selective retardation elements, which are described by ColorLink in prior art U.S. Patent Nos. 5,751,384 (Sharp) and 5,953,083 (Sharp) are color selective waveplates that rotate the polarization state of one color (green, for example) to be orthogonal to the non-rotated polarized light in the other color bands (red and blue, for example). In the ColorQuad arrangement, these specialized retarders are placed adjacent to (or mounted on) the polarizing prisms, as shown as unlabeled dashed layers in the prior art Figure 1 of Pentico '179. Pentico '179, which describes (see paragraph 0042) an optical retarder element that is incorporated into analyzers 235, 245, wherein the analyzers are adjacent to the light combiner 250 (see Figure 2), seems inspired by the ColorQuad prior art. This conclusion is furthered by the statement of Pentico '179 (paragraphs 0038 and 0042) that the retardation element of analyzers 235, 245 may include aspects that may modify or remove light of a pre-determined wavelength or wavelength band.

Pentico '179 then suggests (see paragraph 0042) that the retarder element that is included within the analyzers 235, 245 may also have an optical retardance which is desired to match the residual retardance of the "image assimilator" 230 and thus substantially compensate for the optical retardance of the panel 234. Note that Pentico '179 defines (see paragraph 0035) an "image assimilator" as the combination of the polarizing beamsplitter (wire grid polarizer) 232 and the micro-display/panel 234.

By comparison, the present invention describes display systems and modulation optical systems wherein a polarization compensator 260 is placed adjacent to the spatial light modulator 210, and specifically between the spatial light modulator 210 and the wire grid polarization beamsplitter 240. The polarization compensator 260 of the present invention is described (see page 33, line 15 through page 34, line 2) as typically comprising a multi-retarder stack that can include one or more A-plates (in plane retarders) and C-plates (out of plane retarders). The polarization compensator 260 of the present invention is further described as being potentially provided with a combination of optimized retardances, that may correct for the in plane residual birefringence of the

modulator (LCD), for the non-uniform angular retardance experienced by fast optical beams (small F# beams) passing through the modulator, and for the polarization response variations of the wire grid polarization beamsplitter 210.

Thus, it is evident that Pentico '179 discloses the use of optical retarders to compensate for the optical retardances of the panel or modulator in a distinctly different way than does the present invention. In particular, Pentico '179 places the retarder after the (wire grid) polarizing beamsplitter rather than adjacent to the modulator, and Pentico '179 does not disclose means to compensate for either the wire grid polarization beamsplitter or for the modulator in fast optical beams, either individually, or in combination.

Moreover, Pentico '179 specifically acknowledges that the polarization "noise" or "corruption" from undesired rotation of polarization orientations (see paragraph 0009) is worsened as a polarized light beam passes through additional optical elements. Pentico '179 explicitly observes (see paragraph 0011) that the opportunity to fully and effectively eliminate polarization noise from the light beam is diminished as the tainted light beam passes through successive optical elements. Thus, although Pentico '179 suggests that an analyzer 235 placed after the polarization beamsplitter 232 and adjacent to the light combiner 250 may include optical retardances that can compensate for the display panel 234, Pentico '179 has effectively acknowledged that the Pentico '179 configuration (retarder after the polarizing beamsplitter per Figure 2) will provide compromised polarization compensation for the modulator (panel). Pentico '179 does not then suggest that the retarder may be placed in more optimal locations within the optical system.

It should be noted that the placement of a polarization compensator/retarder which corrects for the display panel, whether before or after the wire grid polarization beamsplitter, is not inconsequential. Polarization contrast is determined by the relative polarization orientation of the desired modulated light versus the polarization orientation of the unmodulated light. As these two polarization states encounter the wire grid polarization beamsplitter, some light is transmitted, and another portion is reflected. As the wire grid polarization beamsplitter inherently defines the outgoing polarization axes in accordance to the wire orientation, the polarization states of the transiting light beams are changed in a non-uniform way. This means that once the light beam

carrying the image data has encountered the wire grid polarization beamsplitter, the local polarization state orientations emerging from the display panel are irrevocably altered and cannot then be corrected/compensated for in an optimum manner. This is true even if the wire grid polarization beamsplitter was perfect and provided a uniform response versus angle, because the wire grid device has still altered/re-defined (to more closely conform to the wire orientation/structure) the non-uniform polarization orientations emerging from the modulator/panel. On the other hand, if the polarization beamsplitter merely uniformly rotated the polarization states of the transiting light, then the compensator could be located either before or after it. Thus, it can be further understood that Pentico '179, unlike the present invention, places its retarder in a location that will not allow optimal compensation for the display panel.

By comparison to Pentico '179, the present invention describes the polarization compensator 260, which is used to potentially compensate for the wire grid polarization beamsplitter 240 (page 23, line 10 through page 26, line 8 and page 28, line 31 through page 30, line 7), the spatial light modulator 210 (page 31, line 29 through page 33, line 14), or for the two in combination (page 33, line 15 through page 34, line 2), as being optimally located between the modulator and the polarization beamsplitter. It should be noted that the present invention not only describes the use of a polarization compensator 260 between the modulator and the polarization beamsplitter, but also the potential use of secondary polarization compensators 265 and 266 (see Figure 10) within this type of system. For example, a secondary compensator 265 can be located after the wire grid polarization beamsplitter, and adjacent to the polarization analyzer 270, which places it in a similar position to the analyzer/retarder of Pentico '179. However, unlike Pentico '179, this compensator placed adjacent to the analyzer is described as providing polarization compensation for the polarization analyzer, rather than for the modulator/display panel.

In summary, Pentico '179 does not appear to a proper prior art reference for the present invention due to the earlier disclosures of Kurtz '378. Additionally, Pentico '179 places its retardation to compensate for the modulator/display panel in a different and non-optimal location, which would result in a compromised compensation and contrast loss. Finally, Pentico '179 does not provide the teaching of present invention (Mi' 663) concerning the

polarization compensation of wire grid polarizers, wire grid polarization beamsplitters, the modulator/display panels in fast optical beams, or for wire grid polarizers and displays in combination.

It should be understood that while the Kurtz '378 patent is relevant, it is commonly-assigned and Kurtz '378 does not disclose contents of the present invention. Certainly Kurtz '378 teaches and claims display and modulation optical systems with elements common to the present invention, that in particular, includes the use of polarization based spatial light modulators, wire grid polarizers, and wire grid polarization beamsplitters with preferred wire orientations. Kurtz '378 also generally introduces the use of a polarization compensator (see Col. 11, line 59 through Col. 12, line 43) in such as system. However, and most importantly, Kurtz '378 does not teach or claim the content of the present invention that pertains to the polarization compensation of LCDs, particularly as needed for fast optical beams, nor as well, to the polarization compensation of wire grid polarizers or wire grid polarization beamsplitters. Nor does Kurtz '378 anticipate polarization compensators that combine the compensation of the LCD and the wire grid polarization beamsplitter in a single device.

Specification

The Examiner has asserted that the title of the invention is not sufficiently descriptive of the invention as it described by the claims. This title rejection is respectfully traversed.

The Applicant has changed the title to DISPLAY APPARATUS AND METHOD. The Applicant is uncertain as to why the Examiner feels the original title was deficient. If the Examiner believes another title would be more descriptive, please call Applicant's attorney to discuss additional amendments.

Claim Objections

The informalities noted by the Examiner in claims 3, 4, 9, 10, 15, 16, 21, 22, 35, 36, 46, and 47 have been corrected via amendment.

Each of the aforementioned claims have been corrected by inserting a clause in the associated independent claims to refer to "sub-

wavelength wires" and then changing the phrasing in these dependent claims to refer to "said sub-wavelength wires" instead of "the sub-wavelength wires".

New claim 102 provides an improved version of many of the prior independent claims, in that it covers a modulation optical system with a wire grid polarization beamsplitter, without the specification of the orientational position of the sub-wavelength wires, but with a more detailed description of the accompanying polarization compensator.

Rejection Under 35 U.S.C. § 102

The Examiner has rejected claims 1, 6, 7, 12, 13, 18, 19, 25, 33, 38, 43, 33, 50-52, 55, 60-64, 66-90, 92-94, and 96-99 under 35 U.S.C. 102(e) as being anticipated by Silverstein et al. (U.S. 2003/0072079). This rejection is respectfully traversed.

The claims of the present application are patentably distinct from Silverstein et al. for the reasons set out below. As the Examiner correctly observes, the co-pending, commonly assigned application by Silverstein et al. (U.S. 2003/0072079) (hereinafter referred to as Silverstein '079), describes several elements common to the present invention. In particular, both applications disclose a modulation optical system and projection system that generally comprise a light source, a pre-polarizer, a wire grid polarization beamsplitter, a reflective spatial light modulator (LCD), a polarization compensator, a polarization analyzer, and image forming optics. Moreover, both applications disclose that the pre-polarizer and polarization analyzer may be wire grid devices, and further that secondary polarization compensators can optionally be provided.

It is however noted that the present invention and the Silverstein '079 application are not disclosing identical systems. In particular, Silverstein '079 describes optical systems that are constructed (see Figure 5) with a double sided wire grid polarizer 400, having sub-wavelength wires 430 formed on both a first surface 410 and a second surface 420. Figures 6a and 6b illustrate how such a double sided wire grid polarization 400 can be used in a modulation optical system 300 either in reflection (Figure 6a) or in transmission (Figure 6b) as input into an imaging system.

The Examiner has noted that the Silverstein '079 application shows, in Figure 4, a wire grid polarization beamsplitter 340 having sub-wavelength wires 350 facing the spatial light modulator 310, with an intervening compensator 360. Silverstein '079 provides the Figure 4 system basically as a set-up to discuss the double sided wire grid polarizer 400 that is depicted in Figure 5. The modulation optical systems 300 then discussed relative to Figures 6a and 6b are basically formed by inserting the double sided device in place of the single side device (see for example, paragraph 0054 of the Silverstein '079 application). Inherently of course, the system of Silverstein '079 provides a condition wherein there are sub-wavelength wire facing a modulator, as well as the illumination system.

To begin with, the Applicant observes that the present invention does not disclose or claim the use of a double sided wire grid polarizer or polarization beamsplitter, whereas all of the independent claims of Silverstein '079 either describe the construction of a double sided wire grid polarizer or polarization beamsplitter, or describe the use of a double sided wire grid device within a modulation optical system. Additionally, the present invention discloses in great detail, over many pages, the use of a polarization compensator, to correct for de-polarization effects of wire grid polarizers, wire grid polarization beamsplitters, or spatial light modulators (including liquid crystal devices), either individually or in combination. The presence of teaching related to compensators in the Silverstein '079 application is as a secondary aspect, with discussion provided relative to the prior Figure 4 system in paragraphs 0032 and 0039-0040, and with discussion provided relative to the systems of Figures 6a and 6b that uses a double sided wire grid polarizer provided in Figure 0057.

In addition to documenting that the present invention and Silverstein '079 do not disclose identical inventions, the Applicant also intends to establish that Silverstein '079 does not anticipate the present invention either by priority or inventorship. Applicant observes that a commonly-assigned and previously discussed prior art patent, Kurtz '378 discloses a modulation optical system and a projection system having many elements in common with both the present invention and the cited Silverstein '079 application. In particular, Kurtz '378 discloses display and modulation optical systems that include the use of polarization based spatial light modulators, wire grid polarizers, and wire grid

polarization beamsplitters with preferred wire orientations. Kurtz '378 also generally introduces the use of a polarization compensator in such as system. Notably, Kurtz '378 does not teach or claim either the contents of the present invention (as was discussed previously) nor the contents of the cited Silverstein '079 application (Kurtz '378 does not disclose the possibility of double sided wire grid polarizers).

Kurtz '378 was filed on March 20, 2001, in advance of both the present invention (filed January 7, 2002) and the cited Silverstein '079 application (filed October 15, 2001). Both of these later applications cited Kurtz '378 (U.S. Patent Application Serial No. 09/813,207, filed March 20, 2001, entitled DIGITAL CINEMA PROJECTOR, by Kurtz et al.) as an incorporated disclosure. Therefore it is established that the aspects of Silverstein '079 that are generally common to the present invention, are mutually in common with the prior commonly assigned Kurtz '378 document. Additionally, it is established that these three documents have partially common inventorship, as can occur in a team project environment. Kurtz, Silverstein, and Kessler are among the co-inventors of Kurtz '378, while Mi, Kurtz, and Kessler are the co-inventors of the present invention, and Silverstein, Kurtz, and Mi are the co-inventors of the cited Silverstein '079 application.

Therefore, in consideration of these various factors, including the differences in the teaching and claims, and the lack of conflict in priority and inventorship, it is respectfully submitted that Examiner's rejection of the aforementioned claims of the present invention under 35 U.S.C. § 102 as relates to the Silverstein '079 is rendered moot, as Silverstein '079 does not anticipate these claims. Therefore, the aforementioned claims (1, 6, 7, 12, 13, 18, 19, 25, 33, 38, 43, 33, 50-52, 55, 60-64, 66-90, 92-94, and 96-99) are considered patentable.

In addition, a Declaration to Disqualify Commonly Owned Patent as Prior Art (37 C.F.R. § 1.130) is attached.

The Examiner has also rejected method claim 43 under 35 U.S.C. § 102 for the additional reason that the Examiner considers this claim to be merely a list, rather than an appropriately described methodology. This rejection is respectfully traversed, however, the claim has been amended to meet the Examiner's rejection.

Rejection Under 35 U.S.C. § 103

The Examiner has rejected claims 2, 5, 8, 11, 14, 17, 20, 23, 34, 37, 45, 48, 56, 59, 91, and 95 under 35 U.S.C. 103(a) as being obvious over Silverstein et al. This rejection is respectfully traversed.

The claims of the present application are patentably distinct from Silverstein et al. for the reasons set out in detail above with respect to the rejection under 35 U.S.C. 102.

Therefore, in consideration of these various factors, including the differences in the teaching and claims, and the lack of conflict in priority and inventorship, it is respectfully submitted that Examiner's rejection of the aforementioned claims of the present invention under 35 U.S.C. § 103 as relates to the Silverstein '079 is rendered moot, as Silverstein '079 does not make these claims obvious. Therefore, the aforementioned claims (2, 5, 8, 11, 14, 17, 20, 23, 34, 37, 45, 48, 56, 59, 91, and 95) are considered patentable.

The Examiner has further rejected claims 2, 8,14, 20, 34, 45, and 56, which describe the use of a compensator that includes one or more birefringent layers comprising at least one of an A-plate, C-plate, or biaxial film as being common and known in the art, and therefore obvious. As these claims are dependent claims, that are linked respectively to independent claims 1, 7, 13, 19, 33, and 44, which have been previously established as patentable and non-obvious, these dependent claims are patentable as well.

The Examiner has further rejected claims 5, 11, 17, 23, 37, 48, 59, 91, and 95, which describe using a liquid crystal display comprised of a vertically aligned liquid crystal molecules as common and known in the art, and therefore obvious. As these claims are dependent claims, that are linked respectively to independent claims 1, 7, 13, 19, 33, 44, 55, 89, and 94, which have been previously established as patentable and non-obvious, these dependent claims are patentable as well.

Allowable Subject Matter

The Examiner has objected to claims 3, 4, 9, 10, 15, 16, 21, 22, 24, 35, 36, 46, 47, 49, 57, and 58 but will allow them if they are rewritten in independent form including all of the limitations of the base claim and any

intervening claims. The independent claims from which these claims depend have been distinguished from the prior art, and are therefore also patentable. The objected informalities connected to these claims have been corrected, and these claims are presented otherwise in their original dependent form.

CONCLUSION

The claims of the present invention have been distinguished from the prior art with respect to both anticipation and obviousness. In the interest of expediting prosecution, however, since the reference and the present invention are commonly-assigned, a Terminal Disclaimer and Declaration under 37 CFR 1.130 are attached. See 35 U.S.C. 102(e).

Dependent claims not specifically addressed add additional limitations to the independent claims, which have been distinguished from the prior art and are therefore also patentable.

In conclusion, none of the prior art cited by the Examiner discloses the limitations of the claims of the present invention, either individually or in combination. Therefore, it is believed that the claims are allowable.

If the Examiner is of the opinion that additional modifications to the claims are necessary to place the application in condition for allowance, he is invited to contact Applicant's attorney at the number listed below for a telephone interview and Examiner's amendment.

Respectfully submitted,

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Enclosures: Declaration under 37 CFR 1.130
Terminal Disclaimer
Supplemental Disclosure Statement
PTO-1449 and References